

IS A BRACHIAL MO
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G. BERGMAR.

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Exposition

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From the Medical Clinic of the University.

Original Article

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ONE of the most important points as regards the differential diagnosis between a cortical and a capsular lesion is no doubt the distribution of the paralysis. In the former case monoplegias are more apt to occur on account of the extensive area of projection, either as a simple monoplegia, one extremity only being affected, or as an associated monoplegia, of which there are two types: a brachio-crural and a brachio-facial type. In the latter case a hemiplegia is always the result (Marie and Guillain).

Further, it is considered characteristic of a cortical, in contradistinction to a capsular lesion, that the coarse power of the hand is less affected than the isolated movements of the fingers and the power of the hand to carry out associated movements (Marinesco, Noïca, Wernicke).

It is generally considered (Monakow, Oppenheim and others) typical of a paralysis of cerebral origin, which may be due to a cortical or a capsular lesion, that the functional disturbance preponderates in the distal portion of the paralysed extremity, although it may involve the most proximally situated muscles, as in cases reported by Clavey. Thus when the paralysis affects

the arm the power of movement at the shoulder- and elbow-joints may be retained, while the hand and, more especially, the fingers are gravely paralysed. This condition, to which attention has specially been called by Bonhöffer, is, according to this authority, constantly found in the case of the arm when the middle third of the central convolutions is involved. Bonhöffer lays stress upon the fact that a cortical lesion never can affect the motility of the shoulder- and elbow-joints and at the same time spare that of the hand.

Clinically it would thus appear that there are no real grounds for speaking of a cortical projection of the special arm-segments in the sense applied by Munk.

No doubt this is rather difficult to explain. Experimental physiology shows that the arm-centre is subdivided into subcentra for the movements of the shoulder-, elbow-, wrist- and finger-joints, a fact which has been confirmed as regards the human body at operations (Krause, Mills and Frazier and others). This being so, one would expect that with a limited lesion of the centre for the shoulder-joint, for instance, the motility of the shoulder would be most affected and that of the hand would be at least relatively unimpaired. Such a case has, as a matter of fact, been described by Allen Starr ("Organic Nervous Diseases," 1903, fig. 166, cit. O. Fischer), where a cyst is depicted in the central convolutions giving rise, it is true, to paresis of the whole arm, but affecting principally the shoulder. Although special reference to this point is seldom met with, still some authors in recording cases incidentally remark that a paralysis of the upper extremity was more marked proximally than distally. Again, Oppenheim (Case 4) has related a case of a tumour in the centre for the leg gradually extending also to the centre for the arm. In this case the paralysis of the arm was most pronounced proximally. In still another case (Case 5) of new growth in the upper half of the central convolutions, the paralysis—at first post-paroxysmal but later permanent—was most definite in the muscles of the hip and shoulder. Löwy, in a case of cerebral arterio-sclerosis, was able to ascertain the presence of paresis in the shoulder, the power of the hand being good; there was, it is true, micrographia, but the finer hand movements were preserved. Into the same category can be placed a case related by Söderbergh in which there were Jacksonian fits beginning in

the knee and weakness of the arm and leg. The weakness was more marked in the shoulder than in the arm, and the finer movements of the hand badly executed. The cause was found to be a tumour of the frontal lobe involving posteriorly the upper part of the anterior central convolution. After operation the paresis of the shoulder rapidly diminished and the patient also recovered the capacity of finer movements. In this case the inability to carry out finer movements was probably due to remote action of the growth, since the patient also showed sensory disturbances although the lesion did not reach the sensory area. Haendly describes a case of paresis of the pectoralis, serratus, deltoid and triceps muscles, the functions of the extensors and flexors of the hand as well as of the small muscles being almost normal.¹ These cases consequently show that a cerebral paralysis may be more definite proximally than distally.

When, on the one hand, the relatively small space occupied by the arm-centre, and, on the other, the great individual variations, are taken into account, it may be affirmed that the exact determination of the various subcentra possible of Sherrington and Grünbaum is alone possible by means of stimulation. So far as I have been able to find, this has not been done in cases belonging to this group, and evidence sufficient to prove the theory of Bonhöffer has still to be brought forward. In order to prove this theory it would be necessary that the paralysis should have a distal distribution, and that the centre for the hand should be proved by electrical stimulation during affection to be intact, the lesion causing the paralysis being situated elsewhere in the arm-centre. Moreover, I have met with a case which directly contradicts the teaching of Bonhöffer. This case, which is of great importance in relation to this question, I shall now refer to in more detail.

The case will be found fully recorded in Henschen's "Path-

¹ Haendly diagnosed hæmorrhage into the retro-lenticular portion of the capsule because of the hemianopsia and hemianæsthesia present. The onset of the lesion, however, points to a softening, not a hæmorrhage. Against the topical diagnosis there is the fact that no sensory channels run into the retro-lenticular part of the internal capsule (Müller); besides this, a type of paralysis like that described by Haendly is unknown in connection with capsular lesions. On the other hand I see nothing in Haendly's case that contradicts a larger parietal softening extending downwards to the visual tract and only slightly affecting the central gyri.

ologie des Gehirns" (Vol. iii., Case 20). The right lower extremity was markedly paretic. There was paresis of the sterno-mastoid. At the shoulder the arm could be raised upwards only 45° . The range of movements taking place at the right elbow joint was normal. Both hands were paretic, but especially the right one. At the operation a tumour was found occupying the posterior central convolution on a level with the centre for the leg. By means of electrical excitation the position of the centres for the muscles of the shoulder and neck were established, it being also ascertained that these were situated very close to the tumour. The tumour was excised. After the operation the right shoulder was dropped and could not be raised. But the forearm could be moved, and pronation and supination, as well as movements of the hand and fingers, could be accurately performed. The leg was highly paretic. Eighteen days after the operation rotation of the shoulder-joint could scarcely be performed, otherwise movements of this joint took place to a range of 45° . At the elbow-joint flexion could be performed to about a right angle, extension was almost normal, movements of the fingers normal. Three months after the operation the mobility of the shoulder-joint was 45° , of the elbow and wrist-joints almost complete. All the movements of the fingers could be performed, though weakly and without precision.

Later on total hemiplegia developed. At the autopsy the tumour, which occupied the upper third of the central convolutions and a part of the gyrus parietalis superior, was found to reach laterally only slightly beyond the level of sulcus frontalis superior.

The fact that before the operation a paresis of the hand was present must be put down to remote action, together with the fact that the other hand showed reduction of the coarse power. This is consequently of less importance. But the course after the operation shows obviously that a process situated immediately above the centre for the shoulder-joint may affect the mobility of the shoulder-joint more than that of the elbow-joint, and the mobility of the latter joint more than that of the hand. Consequently also this case disproves Bonhöffer's doctrine, and shows in the same way as the cases previously related that a cortical process may cause a marked paresis of more proximal parts of the upper extremity.

I myself have quite recently had an opportunity of following more closely an analogous case.

CASE 1.—K. G. H., 70 years old, compositor. He has previously been in good health, except that four years ago he suffered from thrombosis and erysipelas in the right leg, for which he was treated at the Surgical Clinic of Upsala, and from which he recovered completely. About one year ago he had an attack of giddiness, fell down a flight of stairs, and hurt his right shoulder. He was well and on duty again the next day, and has never observed any ill consequences of that trauma. Afterwards he felt neither giddiness nor headache, and has been able to do his work the whole time until November 25. It is specially remarkable that he has never felt any weakness or fatigue in the arm while at work. On November 23 nausea and vomiting began. During the night of November 25, when he got up at 2.30 a.m. to pass water, he noticed that his right arm was weak, and he had some difficulty in speaking. There was no affection of consciousness, as far as those around him could see. At about two o'clock he had been able to speak, and nothing abnormal had then been observed. At about four o'clock the patient was again able to speak.

On admission on November 25 the following notes were taken by Dr Ehrenberg:—There was considerable diminution in all the movements of the right arm; indefinite weakness of the right lower part of the right half of the face. The motility of the legs could not be tested. Patellar reflexes active, but equal in both sides. Tendon and periosteal reflexes active and equal in both arms. Positive Babinski sign.

The urine contained albumin and numerous hyaline casts. The pulse was 80, regular and strong. The aortic second sound was much accentuated.

November 27.—Alb. 0.4 per cent., numerous hyaline casts, sp. gr. 1.018.

November 30.—Alb. 0.6 per cent., hyaline and granular casts, sp. gr. 1.015. Blood-pressure (Riva-Rocci—Landergren), 170 to 180.

December 2.—The face and tongue show no abnormality, and the facial paresis noticeable on November 25 is now gone. No distinct paresis of the leg.

In the upper extremity the paralysis, though considerable distally, is most definite in the proximal parts of the limb. Complete right-sided paralysis on raising the shoulder-region as a whole. Examination of the shoulder-joint is somewhat hampered by the pain which is evoked on passive movement. Even if the arm is raised to such slight degree as not to give rise to any pain, it falls down again, in spite of the patient's obvious efforts to retain it in this position.

At the elbow-joint the power of extension is almost lost, but flexion is better retained. Extension of the wrist and fingers is performed with very small power, but the patient, when the hand lies flexed on a horizontal supporting surface, can almost completely perform the movement of extension. The power of volar flexion is much better retained. The strength cannot, however, be measured by means

of the dynamometer. He is unable to perform isolated finger-movements.

There is intense rigidity in all the joints and in all the directions of movement of the right upper extremity.

December 4.—The movements at the shoulder-joint are still completely paralysed.

At the elbow-joint the power has greatly increased both in flexion and extension. At the wrist-joint the range of movement is the same as on December 2. The strength of the fingers has considerably increased, and he is able to perform isolated movements with the thumb, though not with the other fingers.

The rigidity of the wrist seems to have somewhat diminished. In the finger-joints a slow, involuntary movement of flexion takes place with considerably greater power than that of the corresponding voluntary movement.

The power of the leg is unchanged; he is unable to raise himself.

December 7.—Elevation of the shoulder can be performed, but with far less strength than on the left side. At the shoulder-joint a slight degree of internal rotation and of adduction are possible, but abduction, external rotation and raising of the arm backwards and forwards are impossible. At the elbow-joint the movements of extension and flexion can be fully performed, but with little force.

The coarse power of the hand and fingers is good, both with regard to extension and flexion. Dynamometer, left 18, right 12. Isolated movements can be performed by the thumb, index, and middle fingers, but not with certainty in the two ulnar fingers.

The rigidity in the joints of the fingers and wrists is now decidedly diminished, but is still most definite in the flexors. Rigidity of the flexors at the elbow, although diminished, is still distinct in the flexors, though hardly noticeable in the extensors. At the shoulder-joint the rigidity is much more pronounced, asserting itself chiefly in the internal rotators and in the adductors.

December 10.—Nothing in the shoulder-joint itself can be found to explain the pain attending movements of greater amplitude. Radiography reveals no abnormality. The movements are now not painful until they reach about 60° , when those of abduction, outward rotation, and forward elevation cause pain. In these movements, especially in the last-mentioned, considerable resistance is felt, which the patient cannot suppress. In rotation inwards and adduction there is no rigidity. At the elbow-joint the rigidity of the flexors shows itself when the joint is extended beyond 135° , but the extensors are not rigid. In the joints of the hand and fingers the rigidity is about the same as on the 7th of December.

Elevation of the shoulder is almost equally powerful on the two sides. Internal rotation and adduction of the shoulder-joint are markedly increased. When the arm is lying on a horizontal supporting surface, but not when it is hanging down, the patient can perform small movements of abduction, and is able to raise his arm forwards and upwards from the supporting surface, though only to a very slight degree.

Active movements of the elbow-joint as before.

Dynamometer, right 18, left 20 to 21. Can perform isolated movements with all the fingers. Movements of adduction and abduction without remark in all the joints.

December 12.—At the shoulder-joint there is merely slight rigidity, which becomes evident in abduction and in forward movement. Pain is only associated with movements approaching 90° . The rigidity of the elbow-joint is almost gone and that of the hand and finger-joints much diminished.

Elevation of the shoulder can be performed almost equally well on both sides. At the shoulder-joint, if the arm rests on a horizontal support, the patient can perform abduction, lifting the arm forwards and backwards to about 30° , and in the sitting posture to about $10-15^\circ$. Can raise the arm to about the same height, outwards or forwards, from a horizontal support, and retain it in this position for a short time. But if the arm is raised passively 30° or more it at once falls down, although the movement does not inconvenience the patient.

The motility of the elbow, wrist, and finger-joints is the same as at the preceding examination.

The coarse power of the leg not obviously reduced.

Examination of the sensibility yielded very unsatisfactory results on account of the want of attention on the part of the patient. The muscular sense and the sense of touch seemed to be reduced in the right arm. The stereognostic sense was, however, good.

The reflexes in the arms are active and equal on both sides, as are the patellar reflexes. The scapulo-periosteal reflex is distinct on the left side, absent on the right. No Babinski sign. The abdominal reflex is absent on the right side and uncertain on the left.

December 14.—Pain is felt only when the arm is raised forwards at the shoulder-joint, but it comes on when the movement reaches 30° . The power of adduction, internal rotation, and extension are now fair; that of abduction and external rotation is very feeble, notably so with regard to flexion. Patient is unable to keep the arm raised either outwards or forwards, but in the sitting posture he can keep it raised backwards at about 20° .

Flexion of the elbow-joint is about as strong as on the other side, but extension is much weaker. Pronation and supination are alike on both sides. Dynamometer on both sides 20. Rigidity of the hand and the reflexes remain as on the 12th.

No disorder of the muscular sense in the elbow-joint or in the wrist. No disorder in the joints of the fingers, but the examination of these is unreliable, as the patient cannot quite suppress his own movements of resistance.

The reflexes of the forearm are somewhat more active on the right side. Otherwise the reflexes remain as on December 12.

December 17 to 18.—A slight rigidity of the shoulder-joint is evident when the arm is raised forwards and rotated outwards. There is pain on raising the arm forwards to about 30° and in abduction to about 90° , as well as in outward rotation beyond the median position.

In the sitting posture the patient can move the arm outwards about 20° , backwards about the same, but only slightly forwards, and he is able to rotate the arm outwards to the median position. He can fling the arm outwards 45° and forwards about half that extent, but cannot retain it in those positions. Adduction, internal rotation inwards, and backward lifting are now performed with considerable power, though considerably less well than on the other side. There is no obvious difference between the two sides with regard to elevation of the shoulder.

The power of flexion of the elbow-joint is fair, though decidedly inferior to that of the other side. The power of extension is much more reduced. Dorsal flexion of the hand seems less powerful than on the other side, but supination, pronation, and flexion are performed with equal strength on both sides. The power of ulnar and radial flexion is good, but the patient has some difficulty in actively performing these movements; he is apt to combine them with flexion and supination respectively.

The isolated as well as the combined movements (flexion, extension, abduction, and adduction) are equally strong on both sides. Dynamometer on both sides 18. But the patient gets tired sooner on the right side, so that at the tenth squeeze the dynamometer showed 5 to 6 on the right side, 16 to 18 on the left.

Rigidity of the joints of the wrist and fingers has disappeared; there is still a slight trace of it at the extreme extension of the elbow-joint. Reflexes as on December 14.

December 27.—Cranial nerves show no abnormality. The facial nerve is intact, both as regards voluntary and mimic movements.

The movements of the scapula itself show no difference on the two sides, as regards elevation, depressive adduction and abduction. The paresis is still marked in all movements of the shoulder-joint, especially in abduction, forward elevation and external rotation. From the horizontal position the patient can lift the arm somewhat more than 45° in those directions. (But on trying to fix the scapula with the hand—which, however, did not quite succeed—the excursion was only 30° to 40° .) Complete inward rotation can be reversed into external rotation till somewhat more than middle position. None of these movements, however, can be performed against even a minimal resistance. The power of backward elevation, internal rotation, and especially adduction of the arm, are comparatively much improved, though still markedly inferior on that side as compared with the other. Since the last examination the power of internal rotation shows relatively the most improvement.

The rigidity which at first was strongly marked has now all but passed off (signs of it being still present only on raising the arm forwards). The pain elicited by greater passive movements is likewise less pronounced, the patient now allowing his arm to be lifted forwards and outwards to about 90° and rotated outwards to about 30° beyond the middle position.

At the elbow-joint the power is somewhat reduced, both as regards extension and flexion. At the wrist, movements of pronation,

supination, dorsal flexion, and volar flexion are performed with equal strength and range of movement on both sides; radial and ulnar flexion as before. With regard to the combined as well as isolated movements of the fingers, the power is equal to that on the left side, but the patient gets distinctly more quickly tired in the right hand. The power of more complicated movements is good. There is a minimum of rigidity in the joints of the fingers, wrist, and elbow.

The sense of touch is somewhat uncertain in both hands. The sense of pain is not affected. Examination of the muscular sense, the meaning of which the patient cannot realise, shows uncertainty on both sides, varying greatly, however, as regards degree. Examination of the stereognostic and symbolic sense—"which had some meaning in it"—showed good appreciation of such objects as the patient was accustomed to handle (*i.e.* identified, for instance, a 2-öre piece, 10-öre piece, 5-öre piece, a purse, knife, key, a pair of spectacles, a pencil, but not a stethoscope, an incandescent lamp and an aural speculum).

Reflexes.—Biceps and triceps reflexes are still more marked on the right side, though not nearly so active as before. The radio-periosteal reflex is very lively on the right side, moderately so on the left. The scapulo-periosteal reflex is absent on the right, distinct on the left side. The patellar reflex somewhat more active on the right side. The Achilles jerk is equal on both sides. No Babinski sign. Abdominal and cremasteric reflexes absent on both sides. No rigidity.

January 15.—Shoulder-joint: active abduction to about 70° , forward elevation to 60° , external rotation to middle position; backward elevation, adduction, internal rotation, and raising and lowering of the scapula can be performed to the normal range. The movements of the scapula itself show normal strength. But at the shoulder-joint the strength is diminished as regards all the movements, and the paresis increases relatively in the following order: adduction, internal rotation, abduction, forward elevation, external rotation. There is no atrophy. Electrical excitability is normal. There is no contracture or rigidity; pain only accompanies extreme movements of the shoulder-joint.

Elbow-joint.—Flexion to full excursion, extension to 160° to 170° . The power is somewhat diminished as compared with the other side, especially with regard to extension. No contracture.

Wrist.—Pronation and supination and dorsal flexion showed no abnormality; volar, radial, and ulnar flexion takes place not to quite the same extent, but with the same power as on the other side, and the latter movements can now be performed without being combined with other movements.

The movements of the fingers are now quite as strong on the right as on the left side. No contracture.

The sense of touch and of pain are the same on the two sides. The examination of the muscular sense still gives indefinite results on both sides. The stereognostic perception remains normal.

Tests for Ataxy: the Finger.—Finger test is not quite correctly

performed, the left hand usually passing 1-2 cm. too far in a cephalic direction. On the other hand, the finger-nose test is exactly performed with both hands.

A test for apraxia, carried out the same day according to Wilson's scheme, gave a totally negative result, and on this account I do not think it necessary to report it.

Reflexes as on December 27.

January 31.—Dynamometer, right 28, left 25. After ten squeezes, 10 and 22 respectively. There is no paresis as regards active or resisting movements of the joints of the fingers or the wrist, but there is difficulty in carrying out purely radial or ulnar flexion. Associated and complicated finger-movements are performed slowly, but otherwise correctly. Motility of the elbow- and shoulder-joints is as before (January 15).

Sensibility and reflexes as before.

February 6.—The point of the right foot touches the floor at every step; there is, however, no paresis in dorsi-flexion of the foot. (The gait has not been examined before on account of the general condition.) Babinski sign is positive on the right side.

March 23 (examined at home).—There is still obvious weakness of the shoulder-joint, the movements of external rotation, abduction, and forward elevation being, as before, most affected.

There is slight weakness of extension at the elbow-joint. No paresis of the joints of the fingers or wrist, but the movements are markedly slower on the right side. No sensory disorders can be detected.

The radio-periosteal reflex is increased on the right side, the biceps and triceps are alike on both sides, the scapulo-periosteal reflex is absent on the right side. The knee-jerk is much increased and the Achilles jerk is equal on both sides. Babinski sign negative. There is distinct hypertonus of the tensors of the thigh, but no appreciable hypertonus in the muscles of the calf. The sole of the foot, or more often the heel, is sometimes dragged in walking. No hypertonus of the arm.

May 6 (examined at home).—Flexion and abduction at the shoulder-joint continues much weaker than on the left side. The power of external rotation has markedly improved; but the power of this movement, as well as that of internal rotation and adduction, remain distinctly weaker than on the other side. At the elbow-joint the power of flexion is equal to that of the left side; extension is somewhat weaker on the right side. At the wrist the strength is the same on both sides. Pressure of the right hand is obviously stronger than that of the left. The isolated finger-movements in the right hand are fairly strong, but the movements of the wrist, as well as those of the joints of the fingers, are not a little slower than on the left side. Still they are not fumbling, and they remind one most of the manner in which a patient suffering from spastic spinal paralysis uses his hand. He can, however—even with his eyes shut—button and unbutton his coat with the right hand only; he can also put on his socks and boots, take a pinch of snuff, take a match out of a closed match-box, and—if he supports the box with the left hand—strike the match. The difficulty

in performing these movements, though marked, is yet not very much greater than that ascertained on testing the other hand with regard to its power of performing these movements alone.

No paresis of the movements of the scapula, facial nerve, or leg can be detected.

The scapulo-periosteal reflex is weak on the right side, considerably stronger on the left. Triceps and biceps reflexes are somewhat weaker on the right than on the left side. The radio-periosteal reflex is very strong in the right arm. There is a certain degree of rigidity in the right hand and finger-joints; the rigidity is obviously more marked in the flexors than in the extensors, but this did not appear distinctly until the patient had been sitting undressed for a while in the rather cold room. Apart from this, there is no rigidity of the muscles of the arm. The patellar reflex is very strong on the right side, rather active on the left. The Achilles reflex is equal on both sides. No Babinski sign. There is distinct hypertonus of the tensors of the thigh; no hypertonus of the muscles of the calf. Gait as before (March 23).

The stereognostic power shows no abnormality; there are no signs of ataxy in either extremity.

The paralysis in this case was thus mainly of the proximal type. The history may be briefly summed up as follows:—

There was, to begin with, paresis of the muscles of the trunk, paralysis in the movement of raising the right shoulder; paralysis of the shoulder-joint, intense paresis in flexion of the elbow-joint, and paralysis in extension; very marked paresis in extension of the wrist and the fingers, less intense paresis in flexion of those joints. No paresis of the leg; temporary and uncertain paresis of the facial nerve on the right side. Later on the strength quickly improved in the trunk and as regards elevation of the shoulder. The coarse power of the hand quickly recovered, and became eventually greater on that than on the other side. The power of isolated finger-movements was next recovered, at different times in the different fingers. The patient also recovered the power of complicated and associated movements of the hand, though that function later on became somewhat masked by a second rigidity. At the elbow-joint the paresis improved, to a certain degree as regards extension, and completely as regards flexion. The paresis remained most marked in the shoulder-joint, and here the movements of adduction and flexion remained most affected. At the close of our observation of the case, external and internal rotation, adduction, and extension were less affected. I shall not here discuss the spastic symptoms, as I have done so elsewhere

(Case 23), but shall content myself with pointing out that as regards the leg, in which no paresis had been found, but where the spasm afterwards developed, the proximal and not the distal parts were the seat of this disorder also.

That we have here to deal with a cerebral lesion goes without further saying; the limited symptoms show that it cannot have occupied the capsule (Marie, Guillain, Roussy, and others quoted by Bergmark).¹ Its localisation in the cortex is thus obviously the most probable. Further, the presence of peripheral arterio-sclerosis, the mode of onset, and the very probable cortical localisation, point to the likelihood of the case being one of thrombosis with softening.

One must, however, here consider whether peripheral causes might not have had some influence in causing the paralysis to be most marked at the proximal instead of, as is the rule, the distal parts. There is no evidence whatever of a peripheral nervous lesion of or below the brachial plexus. On the other hand, the pain caused by passive movements might lead one to suspect an arthritis. The patient had suffered from a slight trauma of the right shoulder one year before, but had suffered no inconvenience from it. As, further, the usefulness of his arm in the execution of his work as a compositor was in no way affected, and as neither palpation nor radiography revealed any changes in the joint, arthritis deformans may be excluded.

Still, it often happens that arthritis, in the form of a synovitis (*e.g.* a case by Darkschewitsch, which was examined post-mortem), develops after hemiplegia, and is, as a rule, most pronounced (Steinert) in the shoulder-joint. These arthritic processes do not, however, as a rule develop acutely, but, judging from Darkschewitsch's statistics, not until one to six months after the attack. There was, in Darkschewitsch's cases, in addition to pain on movement, tenderness over the joint and palpable changes in several of the joints. With regard to the present case, I found pain on movement on my first examination of the patient (December 2), but no tenderness could be detected over the joint, nor, as has been mentioned, were there any palpable changes. Further, the pain differed greatly in movements of different directions, and, as a general rule, it was most marked in connection with those movements which stretched the

¹ In my paper upon "Cerebral Monoplegia" appearing in "Brain."

muscles that showed the higher degree of contracture. This tallied with Darkschewitsch's case 8, in which, before any signs of arthritis were present, pain was brought on when the contracted pectoral muscle was stretched; and as in my case the pain disappeared in proportion as the "early contracture" diminished, I think myself justified in inferring that the pain was due to this cause, there being consequently no reason to regard it as a symptom of an arthritis. This disposes, therefore, of the only possible justification of the opinion that an arthritis might have played the part of a direct or indirect cause of the restriction of the movements of the shoulder-joint.

The fact that the paresis remained for a long time after the contracture and pain attending passive movements had disappeared from the shoulder-joint is a proof that the pain cannot have simulated paresis in this case. There was, in fact, intense paresis at the elbow-joint also, though no pain was felt there; nor was contracture at any time so marked there.

Hence there is no reason to suppose that an arthritis may be the cause of the restriction of the movements of the shoulder joint. The pain has, it is true, obviously been due to the contracture, but, on the other hand, it is equally obvious that it cannot possibly have been the cause of the restriction of the movements. I have not been able to find any other circumstances that might have played a part in reducing the motor power of the shoulder joint so much more than that of the more distal parts of the arm; hence I think myself quite justified in drawing the conclusion that this is a case where a cortical lesion has caused a paresis more marked in the proximal than in the distal parts of the arm. As to the leg, no paresis was present there, but the rigidity which developed later affected only its proximal parts, whereas no spastic symptoms were present in the distal parts at the close of the time of observation, not even Babinski's sign being then obtainable. The simplest explanation is unquestionably that of a lesion occupying the centre for the shoulder-joint, and affecting secondarily the nearest part of the centre for the leg, but not those parts situated at a greater distance from the first-named centre.

As it is obvious that any case bearing on the question of whether a brachial monoplegia of cerebral origin may be more

pronounced proximally than distally is of value, I shall here relate three additional cases taken from our Medical Clinic.

The first of these cases being reported in another paper (Case 22), I shall give only those details of the history that are of interest as regards monoplegia of a proximal type.

CASE 2.—K. E., 64 years old, married female. The patient suffered from Jacksonian fits, beginning in the left hand and spreading to the arm and face, followed by weakness of the arm and inability to do finer movements. Later on there was weakness also of the leg. Eight days after the commencement of the illness the active movements of the arm were diminished; the patient could only with difficulty place the arm on her head. Movements of the elbow-joint were weaker on the left side. The dynamometer showed no difference between the two hands, but the grasp of the left hand felt weaker. There was inability to execute finer movements and diminution of the tactile and especially of the muscular sense on the left hand. Astereognosis was present, and later there was apoplexy with total hemiplegia.

From the history of the case it will be seen that the centre for the hand was involved from the beginning (the Jacksonian fits started here), and showed later a distinct disturbance of the motor function affecting the finer movements of the hand, and also some sensory functions closely related to these. The coarse power was evidently much better preserved in the hand than in the shoulder- and elbow-joints.

In the second case the isolated and complicated finger-movements were also conserved.

CASE 3.—P. A. L., aged 60, workman. The patient had been addicted to alcoholic excess from about the twentieth year. Since 1880 he has repeatedly been an in-patient here on account of chronic alcoholism and alcoholic neuritis (partly ataxic neuritis of the lower extremity, partly bilateral neuritis of the ulnar nerve). Gradual signs of cardiac failure developed.

At the end of August 1902 the patient, while drunk, received an injury in the region of the left parietal bone, thereby losing consciousness. The wound was dressed by a barber. The next day the right upper extremity was paralysed with the exception of the fingers. On admission into the Medical Clinic of Upsala on the 4th of November his condition had somewhat improved.

Examination, November 1902 (notes by Mr Elfsberg, M.K.).—Heart considerably enlarged and arrhythmic, 2nd aortic sound metallic. Marked peripheral arterio-sclerosis, pulse hard, 65 per minute. Trace of albumen.

Nervous System.—Cranial nerves apparently normal. The patient

can perform all the movements with the right hand and fingers. Dynamometer, right 19, left 22. Pronation of the forearm is stronger than supination. Extension and flexion of the elbow-joint can be carried out, but with considerably diminished strength. Active flexion only to 45° . At the shoulder-joint the arm can be raised forwards to 20° ; backward extension is also restricted; abduction is reduced to a minimum; external rotation limited; internal rotation as good as on the left side. Movements of the scapula itself are intact. Passive movements of the shoulder-joint are normal. No rigidity nor atrophy. Electrical excitability normal. The motor functions are otherwise quite normal.

Sensibility, as tested with the point of a pin and a camel's hair brush, is somewhat reduced in the ulnar fingers of the left side and the corresponding part of the hand. The sense of place shows no abnormality. The sense of temperature (as tested with water at 15° and 50°) shows no alteration except over the right deltoid, where the difference between the two degrees is not recognised.

Muscular and stereognostic senses are intact.

The triceps jerks are active and equal on both sides. The wrist jerk is absent. Knee jerks are weak. Abdominal, cremasteric and plantar reflexes are exaggerated.

On May 8th, 1908, I had an opportunity of examining the patient, who was then staying at the Upsala Home for Invalids.

Vascular system as before. Nervous system: at the shoulder-joint all passive and active movements can be performed to the full extent. The strength is considerably diminished on the right side, especially as regards abduction and forward flexion. Backward flexion shows no marked difference on the two sides. Internal rotation is distinctly weaker on the right side and so is external rotation. The scapula itself moves normally. The power of extension and flexion of the elbow-joint is somewhat decreased. Dynamometer on the right side 18, on the left 21. There is no appreciable difference as regards the strength of the fingers in isolated movements, these being performed equally well on both sides. The patient can use his hand fairly well for finer movements. There is no ataxia and no disturbance of the tactile or muscular senses. Stereognostic perception shows no change.

Reflexes.—The triceps reflex is more active than normally on the right side and somewhat weak on the left; the biceps reflex is well marked on the right side, weak on the left; the knee-jerk is active on the right, normal on the left side. The Babinski sign is variable on the right side, the plantar reflex constant on the left side; the abdominal reflexes active on both sides. The triceps and pectoralis major are somewhat flabby on this side. The arm measures on the right side 27.5 cm., on the left 27 cm., the forearm 25 cm. on both sides. The right arm feels colder than the left. There is no cyanosis or œdema of the skin.

The chief question here is whether we are dealing with a central or with a peripheral (and if so, evidently a plexus) lesion.

There is no reason to suspect a real brachial neuritis, especially a fresh one.

The patient, a man 60 years of age, with a bad vascular system, received while drunk an injury on the left side of the head, followed the next day by paralysis of the right arm. The paralysis may, of course, have been a direct result of the injury, but, on the other hand, it may have been caused by pressure on the plexus during unconsciousness. The distribution of the paralysis, as this appeared three months later, viz., to the deltoid, triceps, biceps, and brachial muscles, accords well with a lesion of the plexus, according to Erb's type, and so does the diminished power of external rotation of the arm and supination of the hand. The condition of the muscles, on the other hand, is against the assumption of a lesion of the plexus. The paralysis following lesion of the plexus is always of an atrophic nature (Oppenheim), but there was in this case neither atrophy nor alteration of the electrical reaction three months after the commencement of the illness, and when I examined the patient myself, nearly six years later, I found the paresis, although diminished, still evident and almost unchanged as regards its extent, but there was no sign whatever of atrophy. On the contrary, the circumference of the right arm was somewhat increased. The process had progressed none the less to a certain degree, internal rotation of the arm being weaker. Further, some flaccidity of the great pectoral muscle could be noticed on the right side. A similar propagation of the process to the pectoralis major alone may easily be explained by the assumption of a cerebral lesion, but not by the assumption of a plexus lesion, as the nerves supplying the great pectoral muscle, viz., the anterior thoracic nerves, originate from the most proximal part of the plexus. Further, the condition of the reflexes are also against the existence of Erb's palsy (Grenet). During the patient's stay in hospital in 1902 the triceps reflex was active on both sides. When examining the patient myself I found increased reflex irritability of the right arm as well as of the leg; and, in addition to this, Babinski's sign was at this time observed on the right side, though it was inconstant.

These facts seem to justify the assumption of a cerebral lesion as the cause of the paralysis, and in view of the partial type shown from the first by the lesion, it can hardly have been anything but a cortical one.

The case thus shows the existence of a monoplegia of the arm chiefly marked at its proximal parts, and not involving even the isolated and complicated movements of the wrist and fingers.

The fourth case, which also I had the opportunity of observing myself, refers to a paralysis localised mainly in the elbow-joint.

CASE 4.—J. H., aged 44, a farmer. The illness commenced at the beginning of September 1906 with shivers and pain in the chest. Patient has since then been in bed. About one week later speech became difficult; "stiffness of the tongue" and right-sided paresis developed.

On admission, on the 19th of September, the general condition was very bad; the patient was pale and cyanotic; temperature 39.4° C., pulse 102; signs of right-sided pneumonia.

Myosis was present on the right side. Speech was blurred and slow. There was total incomplete hemiplegia. Dynamometer, left hand 25, right 15. There was no disturbance of sensation either as regards the cutaneous or the muscular senses. The knee-jerks were increased on the right side. The reflexes were otherwise normal.

September 22.—There is no facial paresis; the motility of the leg shows no abnormality. The paresis of the arm is also diminished. Dynamometer, right 16, left 20. The strength of the wrist is somewhat less on the right side. The difference is more marked at the elbow, where the power of extension in particular is considerably reduced on the right side. The shoulder-joints also present some difference on the two sides: the arm is raised and abducted less forcibly on the right side. The movements of the scapula itself are practically unaffected.

At a later stage there were frequent and severe rigors, the physical signs being at first unaltered. As the abdomen showed no abnormality and there were no signs of any metastatic process, it was considered probable that an abscess of the lung was developing. Dullness over the right lung, increasing suddenly, and a rapid change for the worse in the general condition were the first signs of an empyema, which was therefore considered to be perforating. The patient was transferred to a surgical ward. The operation showed a perforation of the lung and a communication between the empyema and an intrapulmonary cavity. Death on October 2nd.

Post-mortem examination showed two empyema cavities with well-defined walls, communicating with a cavity in the lower lobe of the lung and two other abscesses in the lung.

Brain.—Over the middle third of gyrus centralis anterior and the adjacent part of gyrus frontalis medius the pia mater showed an area of about 2 cm. diameter with diffuse borders in which there was considerable infection. Corresponding to this area the brain substance was somewhat prominent without any difference in consistence. The

hardened brain showed on frontal section a distinct hyperæmia of the cortex over this area.

Microscopical examination showed obvious changes within this part, viz., considerable hyperæmia of the pia mater, of the cortex, and the most superficial part of the subcortex. Over an area of $\frac{1}{2}$ cm. round the posterior part of superior frontal sulcus the pia mater is highly infiltrated with round cells, especially in the neighbourhood of the vessels. Outside of this area also there are small groups of round cells seen around the vessels. In the most superficial part of the subcortex there was a commencing softening, otherwise only hyperæmia and proliferation of the endothelium. The microscope revealed no changes outside the area of the macroscopical lesion.

The rapid development and very marked improvement of the local symptoms had led to a diagnosis of encephalitis, and this was confirmed by the histological examination.

However interesting this point may be, I cannot discuss it here, but must content myself with touching upon those facts which have a bearing upon the question "proximal paralysis."

The hemiplegia showed a peculiar character. On admission it was total and incomplete; three days later there was a brachial monoplegia, not, as is usually the case, most marked in the hand, but, on the contrary, much diminished there. It was well marked at the elbow-joint, but it could not be ascertained whether it had increased there, as it was impossible to examine the patient minutely at the time of admission on account of his condition.

The pathological cause of this paralysis was found to be an inflammatory process in or near the arm-centre. I can give no detailed localisation of special foci in the affected area, but judging from its size it probably extended considerably beyond the centre for the elbow-joint. This can be accurately determined only by means of stimulation.

The case thus shows that a slight lesion of a great portion of the arm-centre may give rise to marked reduction of the coarse power of the elbow, at the same time almost completely sparing that of the hand. Unfortunately no notes were made in this case as regards the power of isolated and of finer movements in the fingers.

The cases just related seem to prove the possibility of a brachial monoplegia of cerebral origin which is chiefly marked

in the proximal area. In all the four cases described the reduction of the coarse power was least marked in the hand. In Cases 1 and 3 its power of carrying out isolated and complicated movements was fully conserved, as well as the stereognostic perception, although there was a high degree of paresis in the elbow- and shoulder-joints.

Therefore I am in a position to point out, in opposition to Bonhöffer's teaching, that lesions of the middle part of the central convolutions always affect the hand chiefly or exclusively; that there are cases in which a cortical lesion leads to greater functional disorder of a more proximal joint; and that not only the coarse power but also the power of isolated and associated movements (the latter being characteristic for the cortex) may be well conserved in the fingers.

The proximal type of brachial monoplegia to which I have here called attention may with a great degree of certainty be associated with a lesion which, as in Henschen's case, chiefly involves that part of the arm-centre which lies outside the area of projection of the hand.

As this centre is also subdivided into other centres, cases ought to occur in which, provided the above reasoning be correct, the functional disturbance (the paralysis and loss of isolated movements) has affected chiefly or only certain fingers. A considerable number of such cases have, as a matter of fact, been recorded: Gros, paralysis of the thumb and index finger; Lépine, paralysis of the four ulnar fingers; Fox, paralysis of the three ulnar fingers; Zenner, ring and middle fingers; Wernicke, thumb; Monakow (p. 671), thumb and index finger; Mills and Weisenberg (Case 4), the index and middle fingers are first paralysed, later on the ring and little fingers; Bonhöffer (Case 2), paralysis of the opposing muscles of the thumb, and (Case 4) paralysis of the thumb; Kramer (Case 5), index finger; Fischer, paralysis of the three ulnar fingers, especially the ring and little fingers; Binswanger, a large parietal lesion, the paresis most marked in the thumb; Förster, paresis of the interosseous muscle of the little finger, due to a minimal lesion in the anterior central convolution; claw position of the four ulnar fingers after operation.

To the list of such cases, others of which may be found in the literature, I may also add a few.

In one case with Jacksonian epilepsy, on account of a sub-cortical abscess, I could ascertain that the patient, during an attack of severe contractions in the muscles of the shoulder and elbow, retained the power of voluntary movements in the thumb. After the fit, when the monoplegia was otherwise complete, the patient was still able to move his thumb.

In three other cases I found paresis of the fingers varying somewhat in degree, being in the two latter cases least and in the first most marked in the thumb. This was so also in a case lately observed by Professor Petré.

The above statements seem to justify the assertion that from a clinical point of view also one may speak of localisation in Munk's sense of the various subcentra for the arm and hand, as a lesion of the centre for the arm need not necessarily most affect the function of the hand, but may involve some other part of the upper extremity (the elbow or shoulder-joint), and if the hand is implicated its function need not be impaired as a whole, as several cases of more or less isolated paralysis of the fingers are known, and this applies to the coarse power as well as to the isolated movements.

Besides this, Oppenheim's case (Case 5), which I have previously quoted, as well as my own (Case 1), indicate that a paresis or spasm due to a lesion situated above the capsule may also assert itself more proximally than distally in the lower extremity.

With regard to the great majority of cases, however, it holds good, as has been stated by Bonhöffer, that the function of the hand is exclusively or most markedly involved, and this applies not only to cortical but also to capsular lesions. In some cases of vascular lesions of the cortex this can be explained by the distribution of the vessels. The centre for the shoulder lying opposite or somewhat below the sulcus frontalis superior is almost at the boundary of the areas of distribution of the anterior and middle cerebral arteries (Beever), whereas the centre for the hand lies within an area supplied only by the middle cerebral artery. On this account the centre for the shoulder, and to a lesser degree that for the elbow, are more favourably situated as regards collateral blood-supply than is the centre for the hand in cases of vascular lesion within the area supplied by the middle cerebral artery.

This simple explanation, however, may be hardly sufficient

in the great majority of cases where the paralysis is most marked in the hand. One case under my observation cannot be explained in this way. In it there was a brachio-crural monoplegia, the paralysis being most marked in the leg, but showing a distinct distal type both in the arm and leg. Still less can a distal paralysis caused by a capsular lesion be accounted for in this way. A theory has been advanced in explanation of this type, characteristic of cerebral hemi- or monoplegia, referring chiefly to cortical paralysis. It is to the effect that the area of projection of the hand is much larger than that which corresponds to the result obtained by electrical stimulation, and that consequently the centre for the arm is more easily injured (Fr. Müller). It is certainly curious that a diffuse projection should show itself more readily by symptoms of loss of function than of irritation, more especially as cases such as that just recorded, in which voluntary movements in the thumb were associated with proximal spastic contractions during a Jacksonian fit, show that this does not apply solely to experimental electrical stimulation. Even were the projection entirely non-excitabile—which might be due to the function being chiefly of associative character, a supposition which gains ground (Rothmann) from experiments on the higher apes, in which section of the pyramidal tract does not produce loss of isolated finger movements—the result of a widely-spread projection ought rather to be, as Müller has also pointed out, that the non-affected areas compensate for the partial lesion than *vice versa*. Müller has also pointed out that the theory of a diffuse projection has in this way been used to explain why central vision may be unimpaired in cerebral lesions (Monakow, p. 659).

Another hypothesis has been advanced by O. Fischer. As in the case of different animals, the motor functions become more and more dependent, as development increases, upon the cerebral hemispheres, so in the case of man the associated movements of higher development which, as regards the hand, play an important part as compared with "movements as a whole," are most sharply localised in the cortex of the cerebral hemispheres. It follows that the power of compensation must be less good in the case of a lesion affecting their centres. Consequently a lesion in that region must necessarily most permanently affect the differentiated movements, while, on the other hand, the coarse power may be practically restored.

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LITERATURE.

- Beevor. *Brain*, vol. xxx., p. 409, 1907.
- Binswanger. *Charité-Annalen*, vol. viii., p. 498, 1883.
- Bonhöffer. *Zeitschrift für Nervenheilkunde*, vol. xxvi., p. 57, 1904.
- Clavey. "Groupes muscul. paralysés dans l'hémipl. d'orig. cér." *Thèse*, Paris, 1897.
- Darkschewitsch. *Archiv für Psychiatrie*, vol. xxiv., p. 534, 1892.
- Fischer. *Monatss. für Psychiatrie und Neurologic*, vol. xviii., p. 97, 1906.
- Förster. *Monatss. für Psychiatrie und Neurologic*, vol. ix., p. 31, 1901.
- Fox. *Brain*, vol. viii., p. 251, 1886.
- Grenet. *Archiv générale de Médecine*, vol. clxxxvi., p. 424, 1900.
- Gros. *Lyon médical*, 1880, cit. Fischer.
- Haendly. "Hemianopsie und Hemianästhesie," etc. Heidelberg Dissertation, Berlin, 1907.
- Henschen. *Pathologie des Gehirns*, vol. iii.
- Kramer. *Monatss. für Psychiatrie und Neurologic*, vol. xix., p. 129, 1906.
- Krause. *Hirnehirnchirurgie Dric Deutsche Klinik*, vol. viii., p. 953, Berlin, 1905.
- Lépine. *Revue de médecine*, cit. Fischer.
- Löwy. *Monatss. für Psychiatrie und Neurologic*, vol. xviii., Erg. heft, p. 372, 1905.
- Marie et Guillain. *Semaine médicale*, vol. xxii., p. 209, 1902.
- Marinesco. *Semaine médicale*, vol. xxiii., p. 325, 1903.
- Mills and Frazier. "The Motor Area of the Human Cerebrum ; Tumours of the Cerebrum," Philadelphia, 1906.
- Mills and Weisenburg. *Journal of Nervous and Mental Disease*, 1906 (Sep.).
- Monakow. *Gehirnpathologie*.
- Müller. *Sammlung Klinischer Vorträge*, Nos. 394-395, 1905.
- Noïca. *Revue neurologique*, vol. xvi., p. 326, 1908.
- Oppenheim. "Lehrbuch der Nervenkrankheiten," 5. Aufl., Berlin, 1908.
- „ *Monatss. für Psychiatrie und Neurologic*, vol. xviii., p. 135, 1906.
- Rothmann. *Archiv für Anatomie und Physiologic*, Phys. Abth., p. 217, 1907 (Sep.).
- Roussy. "La couche optique," Paris, 1907.
- Sherrington and Grünbaum. *Royal Society Proceedings*, vol. lxix., p. 206, 1901.
- Söderbergh. *Hygica*, vol. lxxix., p. 616, 1908.
- Steinert. *Deutsches Archiv für klinische Medizin*, vol. lxxxv., p. 445, 1906.
- Wernicke. *Arbeiten aus d. Psych. Klinik in Breslau*, Heft 2, p. 33, 1895.
- Wilson. *Brain*, vol. xxxi., p. 164, 1908.
- Zenner. *Journal of Nervous and Mental Disease*, vol. xiii., p. 438, 1886.



